COoperative **Y**early **O**perational **T**echnology **E**valuation

COYOTE '98

A Distributed Mission Training Experience
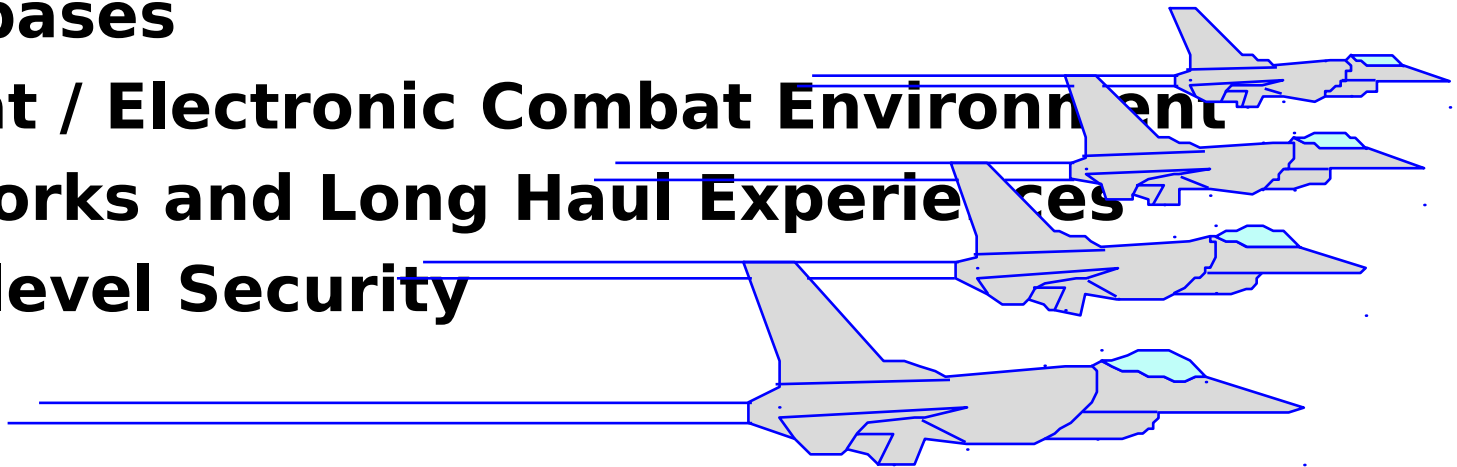
DMT Technical Forum

Distributed Mission Training Technology Discussion Areas

- **DMT Testbed**
- **Advanced Cockpits**
- **Control Station**
- **STOW**

- **Advanced Visual and Display Systems**
- **Databases**
- **Threat / Electronic Combat Environment**
- **Networks and Long Haul Experiences**
- **Multilevel Security**
- **HLA**

Technical Objective: DMT Testbed
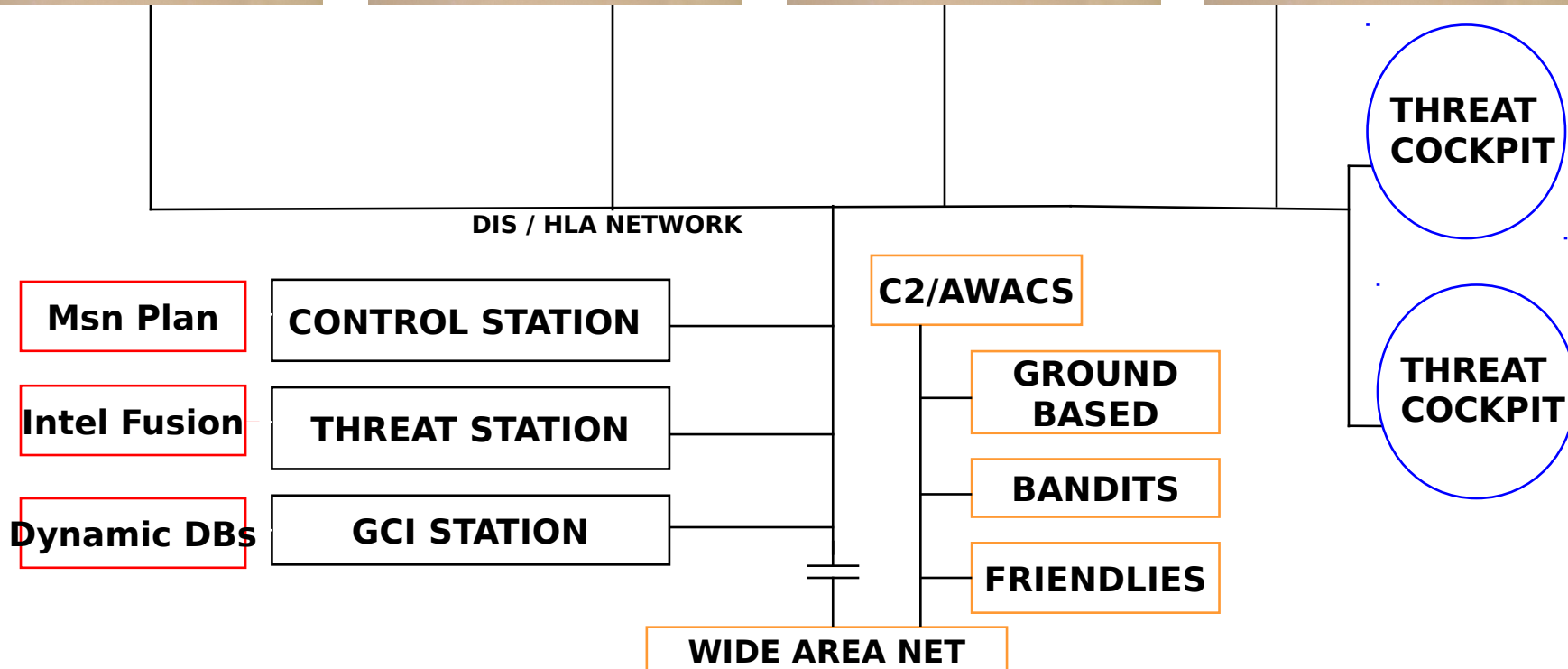
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AFRL/HEA Testbed

DIS / HLA NETWORK

Msn Plan	CONTROL STATION
Intel Fusion	THREAT STATION
Dynamic DBs	GCI STATION

C2/AWACS

GROUND BASED

BANDITS

FRIENDLIES

WIDE AREA NET

THREAT COCKPIT

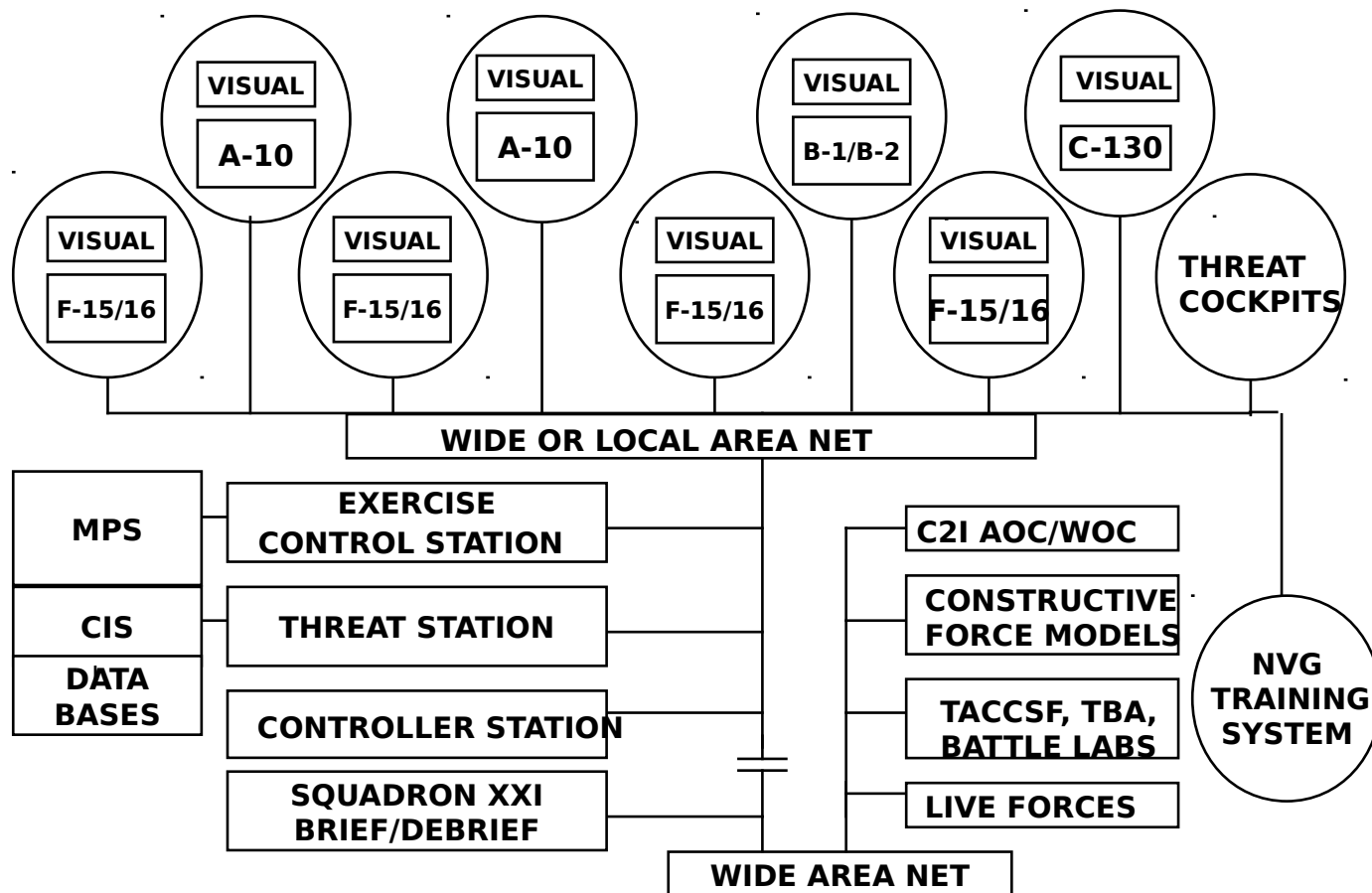THREAT COCKPIT

Technical Objective: DMT Testbed

- R&D for testbed technologies and methods to advance warfighter training
- Larger scale long haul network will be established between AFRL facilities and those of other services / directorates

Technical Objective: DMT Testbed

Technical Objective: Cockpit Systems

Technical Objective: Cockpit Systems

- DMT Testbed requires integration of variety of modular cockpits
- Tackle tough problems not yet addressed with different aircraft versions of sims
- Address high risk, high payoff areas in simulator development such as software, image generation, integration of threats, and hardware design issues
- Legacy system integration

Technical Objective: DMT Control Station

Technical Objective: DMT Control Station

- Viewpoint / Control for many personnel
  - Instructors, Mission Directors, VIPs, Observers
- Combines training environment management with traditional Instructor Operator Station (IOS) functions
- Provides users the tools to control and monitor all phases of the simulation event or scenario
  - Mission development, preflight, initialization, execution, termination, data
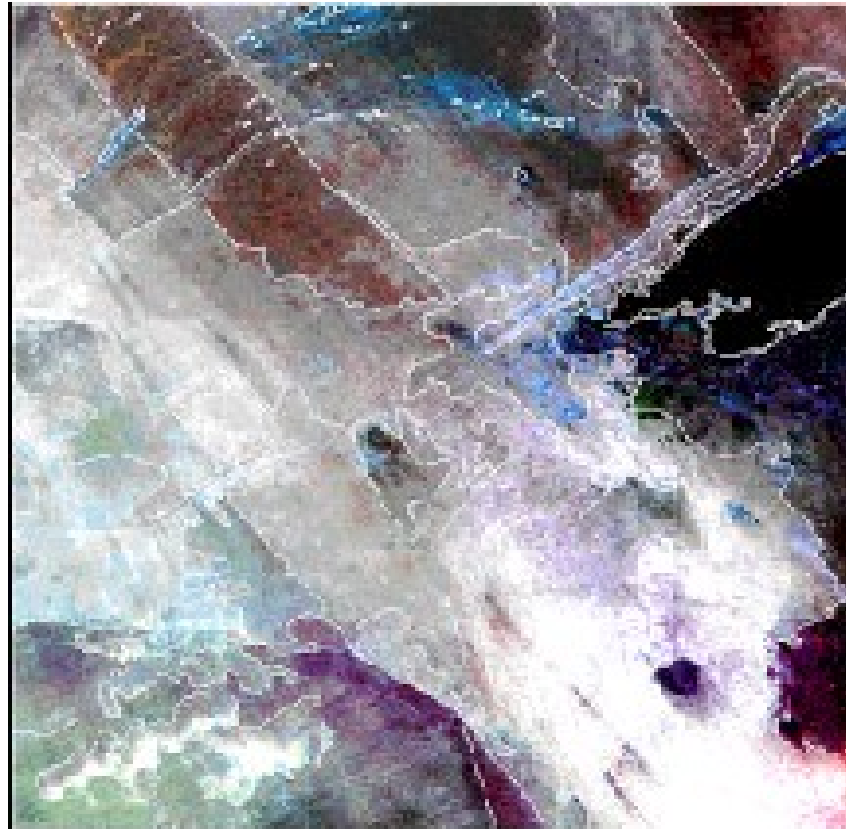
Technical Objective: Advanced Briefing and Debriefing Tool

Technical Objective:
Synthetic Theater of War Technology
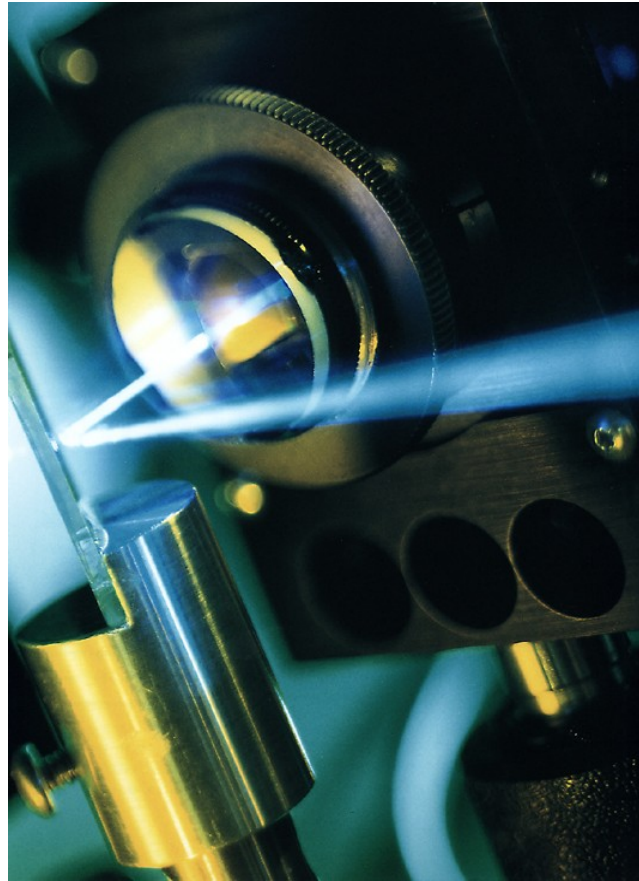
Technical Objective: Visual Display System

Technical Objective: Visual Display Systems

- Different display technologies and methods
- Enough fidelity (contrast, brightness, resolution, field-of-view, and scene complexity) to support both air-to-air and air-to-surface missions
- Cost effectively address shortfalls in visual systems used for aircrew training
- Evaluate and develop new technologies
  - Full color rear projection display projector capable of displaying area of interest inset with 20/20 visual acuity resolution

Technical Objective: Microlaser R&D

Technical Objective: Microlaser R&D
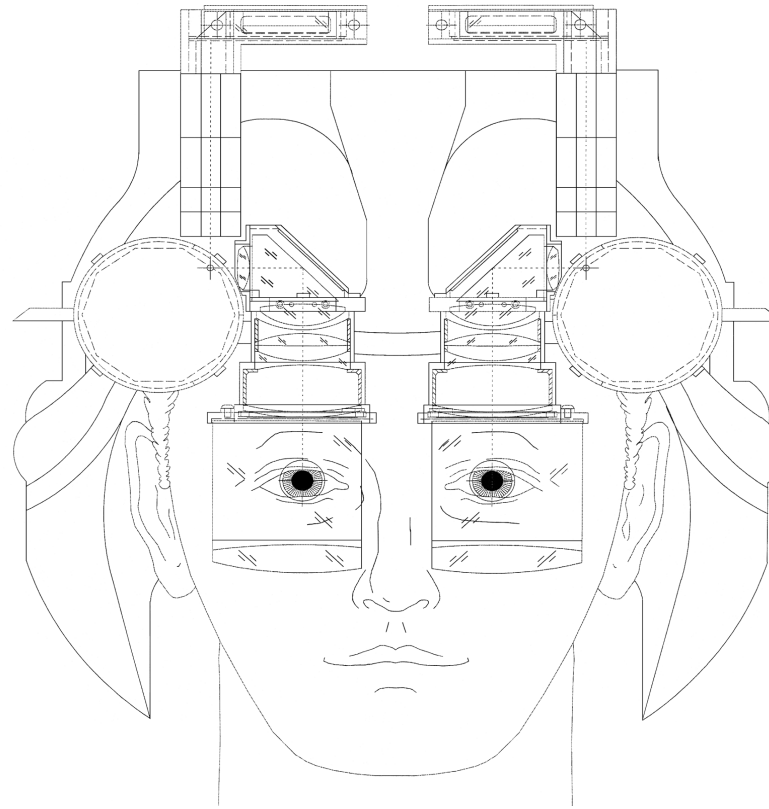
- Micro-Laser Based Projection System
  - Need 20/20 visual acuity for targets in the visual scene
  - Address Air-to-Air and Air-to-Ground Visual System Shortfalls
  - Current CRT-based systems usually = 1,300,000 pixels or less (1280 x 1024)
  - Future Micro Laser-based system = 20,000,000 pixels
- 5120 pixels x 4096 lines, Color Laser Projector
- Helmet-mounted Laser Displays, HDTV level

Technical Objective: High Resolution Microlaser Based Helmet Mounted Display (HMD) (SBIR)

Technical Objective: High Resolution Microlaser Based Helmet Mounted Display (HMD)

- SBIR with Laser Power Research
- Beginning development of a High Definition Television (HDTV), HMD weighing under 5 pounds, and utilizing solid state high resolution microlaser technology
- Develop large 80 degree fully overlapped field-of-view (FOV)
- See-through HMD for out-the-window visual displays for warfighter training
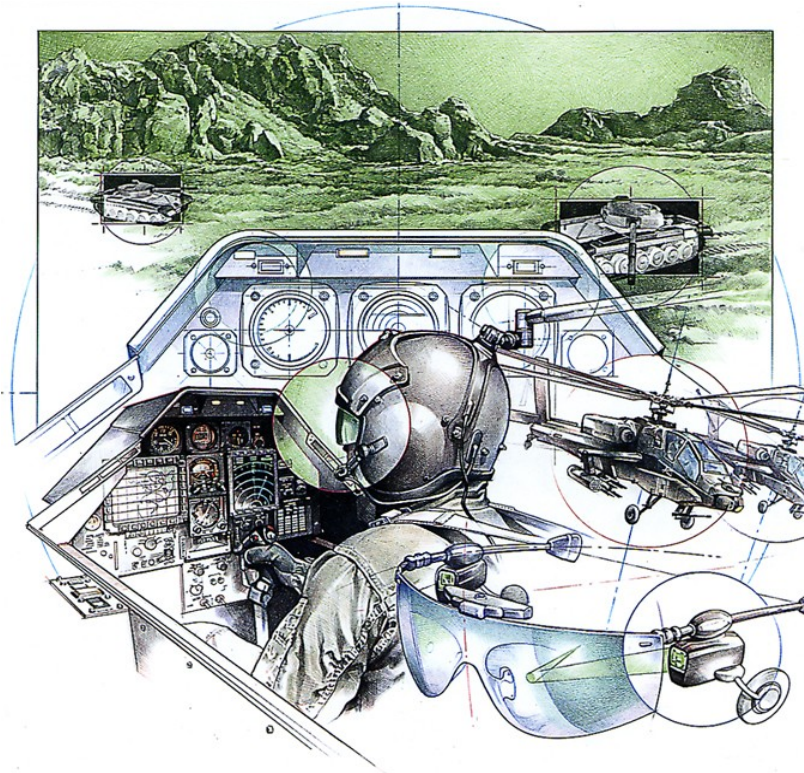
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chnical Objective: High Resolution Helmet Mount
Virtual Retinal Display (SBIR)

Technical Objective: High Resolution Helmet Mounted Virtual Retinal Display (VRD)

- SBIR with Microvision
- Currently in development is a 1920 x 1080 HDTV, helmet-mounted VRD weighing less than 4 pounds
- Uses Micro Electro-Mechanical Systems (MEMS)
- Develop 30 degree FOV
- Another approach for see-through out-the-window HMDs for warfighter training

Technical Objective: Personal Computer (PC)-Based Image Generator (IG) (SBIR)

- SBIR with MaK Technologies
- PC-based three-dimensional graphics have made significant strides and now accelerate many aspects of graphical visualization
- Low cost systems could reach the capabilities required for demanding DMT flight simulation at a fraction of the cost

Technical Objective: M2DART

Technical Objective: Modular Miniraster Display for Advanced Research Technology (M2DART)

- New type of flight simulator visual display
- Two requirements define adequate resolution for M2DART
    - Resolve line pairs separated by 2 arc-minutes in a full-field display
    - Extend range for recognition of aspect angle

hnical Objective: Real-time Image Generat

Technical Objective: Real-time Image Generation

- DMT uses numerous and dissimilar types of real-time computer image generation (CIG) devices
- Provide imagery for all simulator cockpit visual out-the-window and sensor(s) scenes
- Support air-to-air and air-to-ground operations
- Interfaces to networking, threat, weapons, night vision goggle, various displays, semi-automated forces, mission planning, and intel systems

Block Diagram of Visual Interface Unit (VIU)
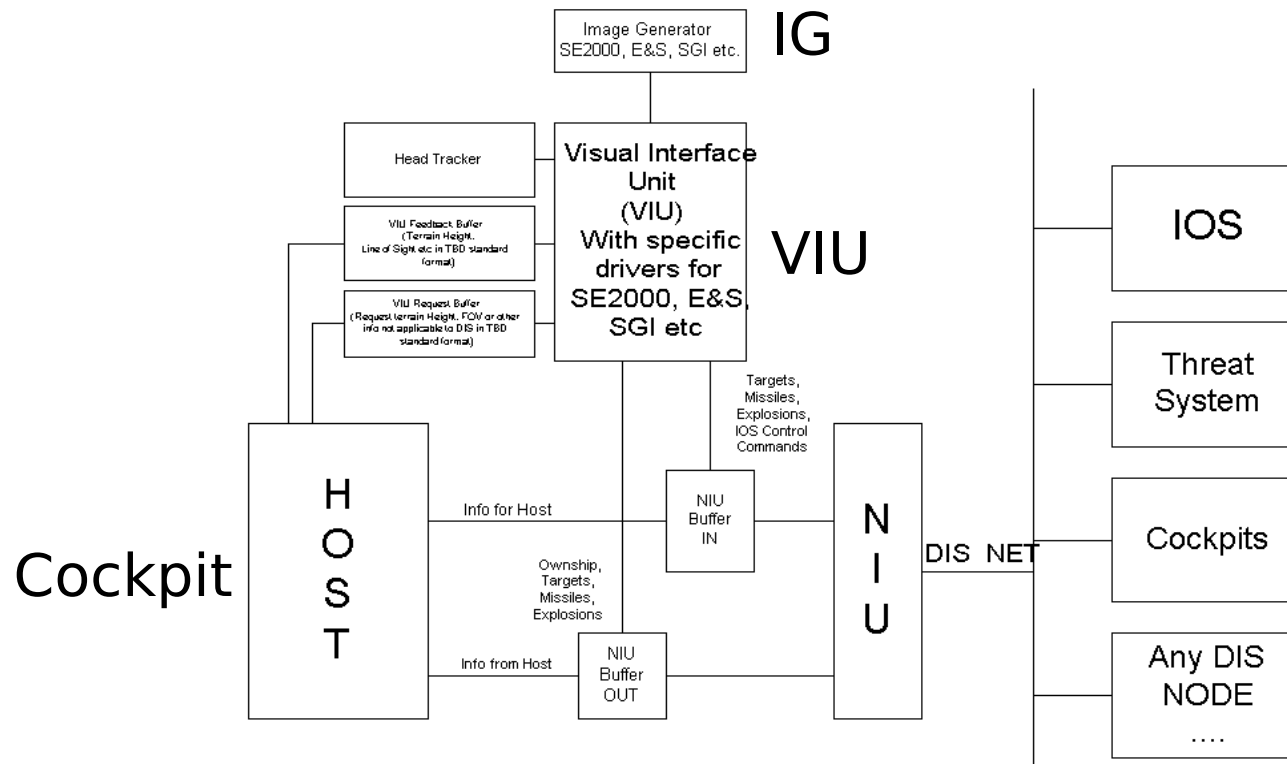
Technical Objective: Visual Interface Unit

Technical Objective: Cockpit / IG Visual Interface Unit (VIU)

- Current interface between host cockpit and IG requires custom software solution every time a new IG mated to new cockpit
- VIU will provide common software solution regardless of IG
  - Eliminate difficulty of interfacing various IGs to the different cockpits
  - Require only minor mods to host code to provide variables needed by VIU

chnical Objective: Three-Dimensional Disp

Technical Objective: Database Generation

Technical Objective: Database Generation

- Problems:
  - Currently disparate systems for IGs
  - No standardization or control
- Require database geographic coverage of selected locations for all DMT studies and tests
- Correlated across all image generator types and across all visual and sensor types
- Accurate and correlated
- Moving models
- Special effects

Technical Objective: Dynamic Database System Development

- This development effort will produce databases for the image generators that change "on-the-fly" as the mission evolves
- Accurately represent the events that take place in real-time

Technical Objective: Correlated Sensor Imagery

- The out-the-window visual systems will accurately portray the same environment displayed on on-board sensors, such as the radar
- Forward Looking Infrared Radar (FLIR)
- Digital Radar Landmass System (DRLMS)
- Maverick

Off-boresight degradation
Realtime beam pointing

EWIR-level accuracy
- pulse & frequency agility
- scan pattern

Clutter bin masking

Real terrain (level 1 OTED)
Terrain-specific clutter (Surface code from DF

Technical Objective:
Electronic Combat Environment Dev

Technical Objective: Electronic Combat Environment Development

- Need a high fidelity, accurate, validated, threat system
- Main goal is to provide a threat system whose modes of operation reflect interaction with real-world effects, such as terrain clutter
- Require effective control station and image generator interface, enemy (RED) Communications and Control, valid electronic environment
- Incorporate realistic threat emitters

Technical Objective: Threat Models

Technical Objective: Threat Models

- Facilitate man-in-the-loop simulation of threat models
- Using DoD sources for validated models
- Representative aerodynamic and weapons models for multiple enemy (RED) aircraft
- Models must stand the scrutiny of validation test
  - Performed in accordance with AFPD 16-10, Modeling and Simulation Management, under AFI 16-1001, Verification, Validation, and Accreditation (VV&A)

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Technical Objective: Threat Cockpit

Technical Objective: Threat Cockpit

- Develop and field a threat cockpit for friendly exploitation and training
- Include the following:
  - Six degrees of freedom (DOF) flight model
  - Reconfigurable aircraft type / weapons load
  - Replicate detection capability, visual ranges, maneuverability, weapons employment, weapons performance, and fire control mechanization of designated threat aircraft
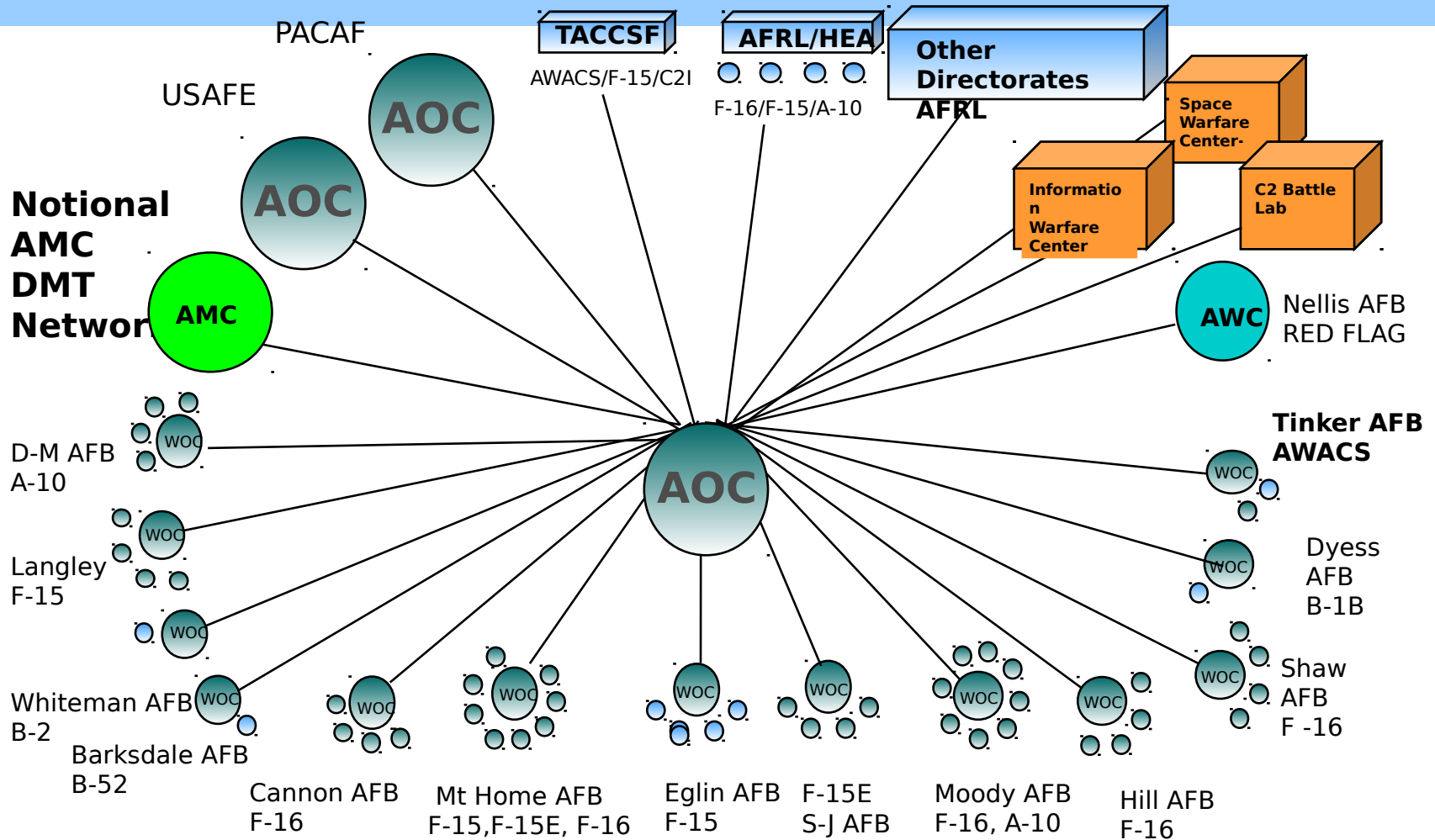
Technical Objective: Virtual Aggressor Environment Development

- Allows training in peacetime that currently does not exist anywhere
- Includes family of devices from part task trainers to high fidelity human-in-the-loop simulations
- Establishment of a virtual aggressor testbed allows experimentation to determine optimum mix of hardware necessary for effective warfighter training

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PACAF

USAFE

Notional
AMC
DMT
Network

TACCSF
AWACS/F-15/C2I

AFRL/HEA
F-16/F-15/A-10

Other
Directorates
AFRL

Space
Warfare
Center·

Information
Warfare
Center

C2 Battle
Lab

AOC

AOC

AMC

AWC   Nellis AFB
RED FLAG

D-M AFB
A-10

WOC

Langley
F-15

WOC

WOC

AOC

Tinker AFB
AWACS

WOC

Dyess
AFB
B-1B

WOC

Whiteman AFB
B-2

WOC

WOC

WOC

WOC

WOC

WOC

WOC

Shaw
AFB
F -16

Barksdale AFB
B-52

Cannon AFB
F-16

Mt Home AFB
F-15,F-15E, F-16

Eglin AFB
F-15

F-15E
S-J AFB

Moody AFB
F-16, A-10

Hill AFB
F-16

Technical Objective: Networking

Technical Objective: Networking

- System integration of various resources over both local area networks and wide area networks
- Networking R&D supports all aspects of DMT system
- Explore:
  - Bandwidth requirements for DMT
  - Interconnectivity of geographically dispersed sites
  - Latency over long-haul networks
  - The impact and/or meaning of the various latencies

DMT Technical Forum

VIRTUAL

LIVE

CONSTRUCTIVE

CTAPS
ACPT
MSS II
AMPS
WCCS
Ops
Simulators

REAL WORLD SYSTEMS
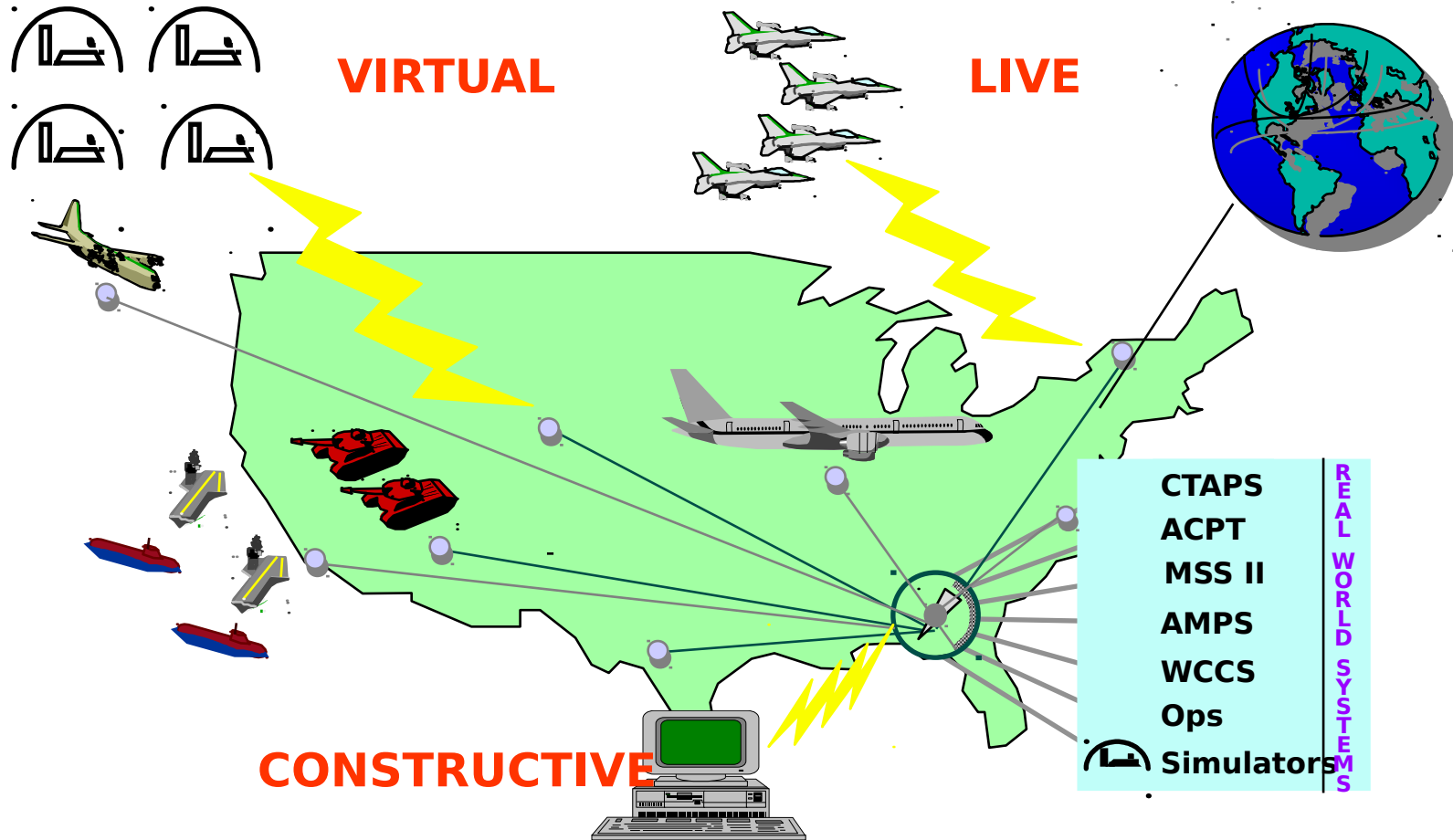
...ive / Virtual / Constructive (L/V/C) Interface...

# Technical Objective: Live / Virtual / Constructive (L/V/C) Interfaces

- Integrate live, virtual, and constructive entities in DMT environment
- Provide demonstrations / exercises using available resources
- Examine and measure training effectiveness
- Focus on platforms associated with wartime operations
  - Modular Control Equipment (MCE)
  - Airborne Warning and Control System (AWACS)

DMT Environment
Long Haul Experience

- **Multi-Distributed Training Testbed (MDT2)**
  - **Close Air Support (CAS)**
  - **Air to Air**
- **Synthetic Theater of War**
  - **Europe (STOW-E)**
- **Fighter Fatigue**
- **Warfighter**
- **Joint Combat Search and Rescue (JCSAR)**
- **Warrior Flag '97**
- **Combat Identification (Combat ID)**
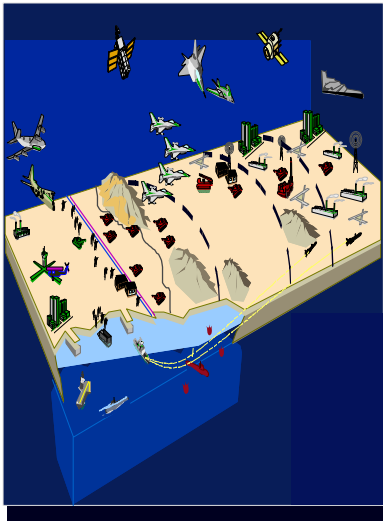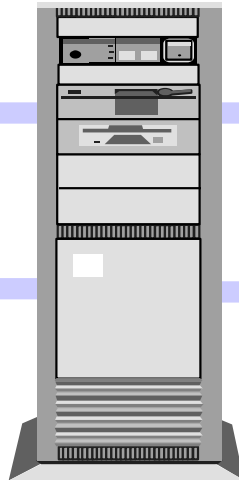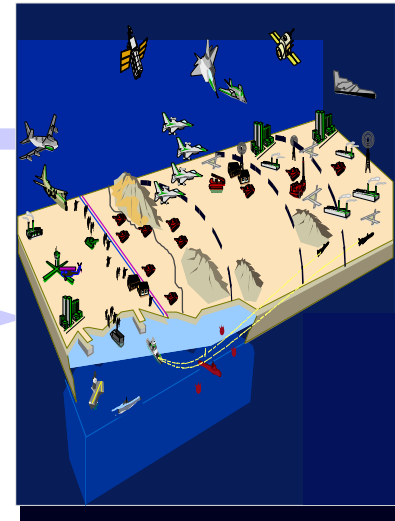- **Roadrunner '98**
- **EFX '98**
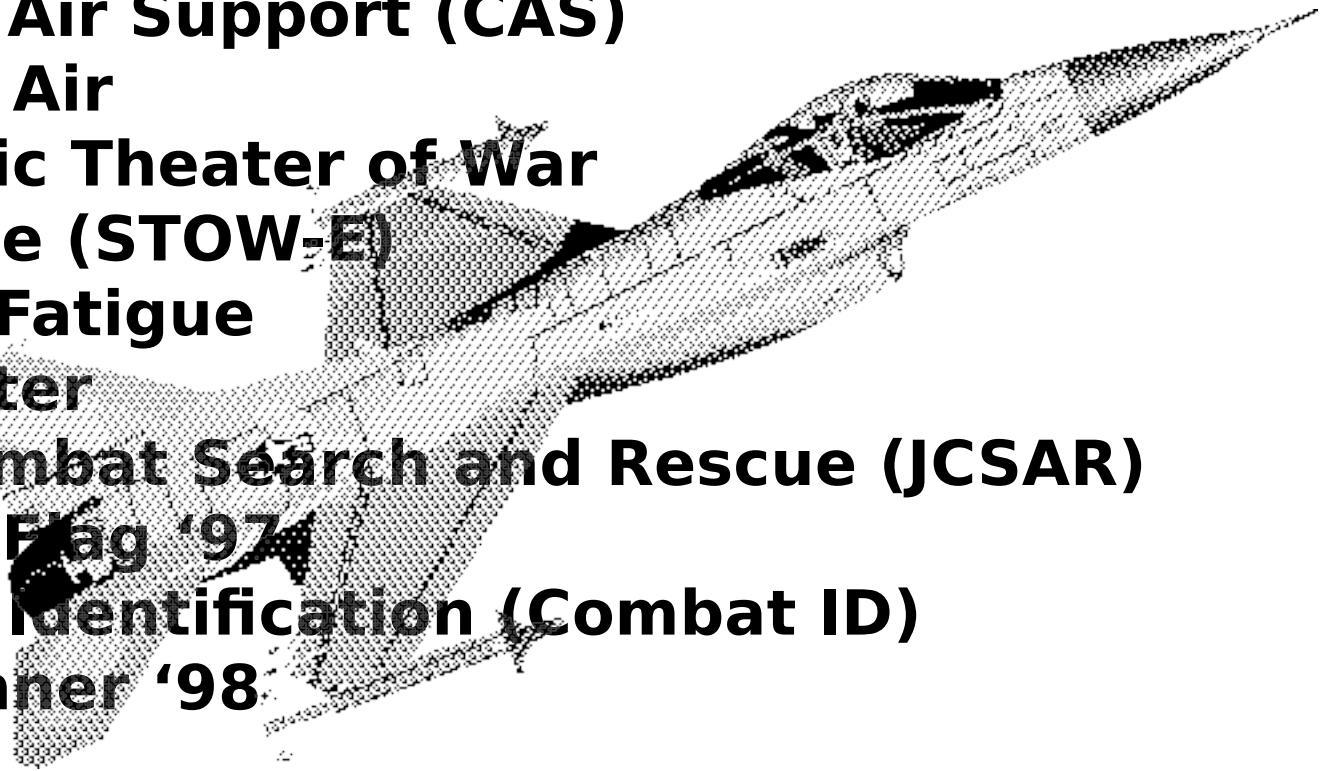
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Higher
Security
Level

Firewall

Lower
Security
Level

hnical Objective: Multilevel Security Mana

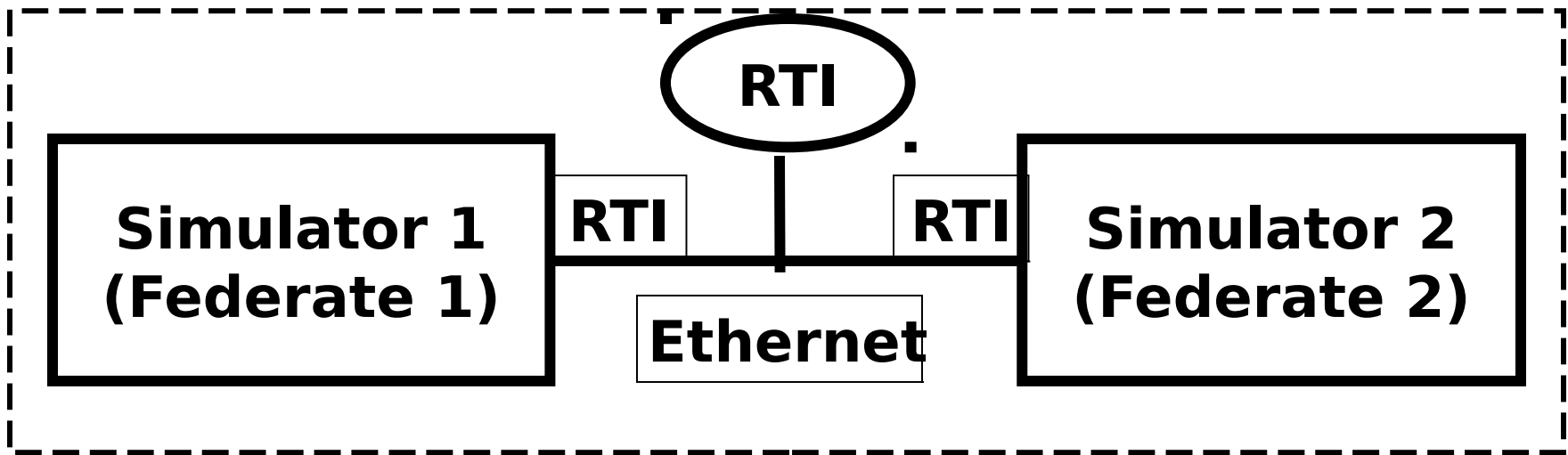# Technical Objective: Multilevel Security Manager (MLM)

- Pursue research and development of systems that address the requirement for multi-level security networks for DMT
- Real-time (60Hz) system
- Connects different levels of simulator classification
- Larger DMT system requirements still not addressed
- Never been done for real-time (60 Hz) high fidelity flight simulation
- Challenging accreditation requirements

Simulators Networked in HLA Manner

Federation

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        ┌─────────────────────────────────────────────┐
        ┊                      ╭───────╮               ┊
        ┊                     (  RTI   )               ┊
        ┊   ┌───────────────┐  ╰───┬───╯  ┌───────────────┐
        ┊   │               │┌────┐│┌────┐│               │
        ┊   │  Simulator 1  ││RTI ││││RTI ││  Simulator 2  │
        ┊   │ (Federate 1)  │└────┘│└────┘│ (Federate 2)  │
        ┊   │               │   ┌─────┐   │               │
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        └─────────────────────────────────────────────┘
```

RTI

RTI   **RTI**

**Simulator 1
(Federate 1)**

**Simulator 2
(Federate 2)**

Ethernet

echnical Objective: High Level Architectur

Technical Objective: High Level Architecture (HLA)

- Relatively immature / undefined for high-fidelity real-time flight sims
- AFRL will become DMSO beta site for the VxWorks, PowerPC real-time version of the RTI 1.3NG
- AFRL/HEA working with DMSO, industry and DoD
- As HLA evolves, the simulator testbed and training environment must evolve also
- Investigate latencies and their impact, if any